3D analysis of RAW 2010 Tighar Nikumaroro ROV HD Video

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1. Introduction

Regarding our raw data request, we received an external drive that has 3 folders:

1. GoPro HD
2. HD Full Res
3. Niku ROV

The videos in the first folder, *GoPro HD*, are irrelevant for our analysis.

The other two folders, *HD Full Res* and *Niku ROV*, contain 2010 Tighar Nikumaroro ROV videos. *Niku ROV* contains standard definition and down-scaled version of "full" HD videos, and *HD Full Res* contains a single folder, *25May10*, of 39 videos captured at "full" HD resolution (1440x1080, interlaced, aspect ratio (AR) 16x9, pixel ratio (X/Y) 1.33).

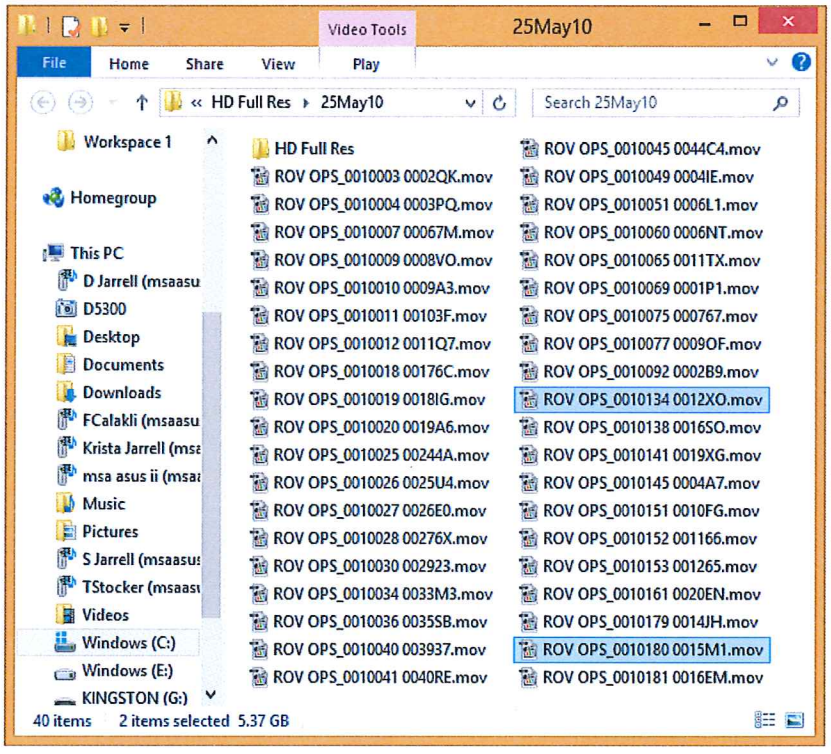
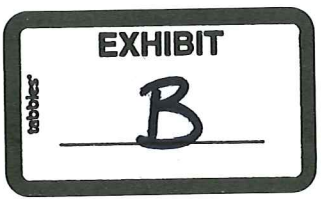


Figure 1 2010 RAW ROV video files contained in HD Full Res folder



For our analysis, we have used ROV OPS_0010134 0012XO.mov, and ROV OPS_0010180 0015M1.mov.

One quick observation is that the new video sequences do not have time-stamps. This makes our 3d analysis easier and more reliable because video frames cover more area in the ocean floor.

Figure 2 the 2010 HD video

Figure 3 the 2010 RAW ROV HD video

3. Preprocessing RAW ROV Video

Since these video sequences are raw, we apply a series of preprocessing steps to decode and render video frames at highest possible quality.

Extracting the header information from the video

A video header is shipped every video and contains several useful information such as the camera model used for capture, sensor size, aspect ratio, video encoding format, date etc.

We retrieved the header from video ROV OPS_0010134 0012XO.mov (see Figure below) so that we can decode video frames, and render at highest quality possible.

ROV OPS_0010134 0012XO.mov.txt

```
General
Complete name                            : C:\Users\fatih_000\Workspace\Earhart\video_clips\RAW\HD Full Res\25May10\ROV OPS_0010134 0012XO.mov
Format                                   : MPEG-4
Format profile                           : QuickTime
Codec ID                                 : qt
File size                                : 3.69 GiB
Duration                                 : 8mn 32s
Overall bit rate                         : 61.9 Mbps
Encoded date                             : UTC 2010-11-19 03:49:43
Tagged date                              : UTC 2010-11-19 03:49:43
Writing library                          : Apple QuickTime
com.panasonic.professionalplugin.p2.clip : 2010-06-06 18:42:30 -0700
com.apple.proapps.reel                   : ROV Selects 6-7-10
org.smpte.mxf.identification.filemodific : 2010-06-06 20:33:58 +0000
org.smpte.mxf.identification.application : 0x060E2B34040101090E0E010101000001
com.apple.quicktime.creationdate         : 2010-06-06T18:33:57-0700
org.smpte.mxf.package.material.packagena : ROV OPS_0010134
com.panasonic.professionalplugin.p2.clip : MS
com.panasonic.professionalplugin.p2.clip : 2010-06-06 18:33:57 -0700
com.panasonic.professionalplugin.p2.clip : AME_Nai'a_ Nikumaroro
org.smpte.mxf.package.material.packageid : 0x060A2B340101010501010D43130000009C5C2110545305E40080458264F31019
com.panasonic.professionalplugin.p2.clip : Bernanke
org.smpte.mxf.package.material.packagela : 2010-06-06 20:33:58 +0000
com.panasonic.professionalplugin.p2.clip : SHOOTING
org.smpte.mxf.identification.application : 2.0
com.panasonic.professionalplugin.p2.clip : AG-HPG20P
com.panasonic.professionalplugin.p2.clip : Panasonic
com.panasonic.professionalplugin.p2.clip : ROV OPS_0010134
com.panasonic.professionalplugin.p2.clip : Amelia
com.panasonic.professionalplugin.p2.clip : 2010-06-06 18:33:58 -0700
com.panasonic.professionalplugin.p2.esse : F2022481
com.panasonic.professionalplugin.p2.clip : TRUE
com.panasonic.professionalplugin.p2.clip : C0INB0035
com.apple.proapps.originalFormat         : AVC-Intra 1080i60
com.panasonic.professionalplugin.p2.clip : Mark Smith
org.smpte.mxf.identification.application : Panasonic
org.smpte.mxf.identification.application : P2
org.smpte.mxf.package.material.creationt : 2010-06-06 20:33:58 +0000
org.smpte.mxf.identification.generationi : 0x6804358200D24856B2F8658834F3746A
com.apple.proapps.clipID                 : 060A2B340101010501010D43130000009C5C2110545305E40080458264F31019
com.panasonic.professionalplugin.p2.clip : 2010-06-06 18:42:30 -0700
Media/UUID                               : 0C09F8EC-EF2E-4E29-BE0C-44E75CE4E845
```

Figure 4 Header of ROV OPS_0010134 0012XO.mov (complete header is in the appendix)

The header reveals that the camera type, AG-HPG20 P2 Portable HD recorder/player, and the real video capture date, 6/6/2010, which actually contradicts with the name of the folder, 25May10.

Figure 5 Panasonic's AG-HPG20 Portable Recorder (specs can be acquired from Panasonic's website)

Figure 6 Sony FCBH11 High Definition Color Block Camera (specs can be acquired from Sony's website)

Our findings in the header are consistent with the article posted on creative planet network blog (http://www.creativeplanetnetwork.com/videography/news/dp-mark-smith-explores-p2-equipment/27301) which says:

> *"Participants on the 2010 expedition will clear the jungle for an intense study of the Seven Site; personnel will also operate a video-equipment ROV for an underwater search for traces of Earhart's Lockheed Electra. Smith will shoot in AVC-Intra 100 at 1080/30pN on the HPX370 and in DVCPRO HD 1080/30p on the HPX170. He will utilize the P2 Portable's HD-SDI input to record AVC-Intra 100 1080/60i from the remotely-operated underwater camera. He will use the HPG20 and HPG10 as card readers, with the PCD2 as backup. Smith is traveling with hard drives with 16TB of storage, and will routinely offload footage to a CalDigit VR mini bus-powered, two-drive RAID system."*

De-interlacing video frames

Using the proper codecs (AVC-Intra 100) to read and decode frames, we observe that there are 30 frames in a second, and each frame combines two different fields (half frames) in time to form a single image.

This technique is known as interlaced video which is used for doubling the perceived frame rate of a video display without consuming extra bandwidth. Two half frames are weaved together horizontally to form a single frame. The very top pixel row of the frame will display the top row from Field number one. The second row on the frame will display the top row from Field two. Frame row three will contain the second row from Field one, and frame row four will display the second row from Field two. This alternating row pattern is repeated all the way from the top to the bottom of the frame.

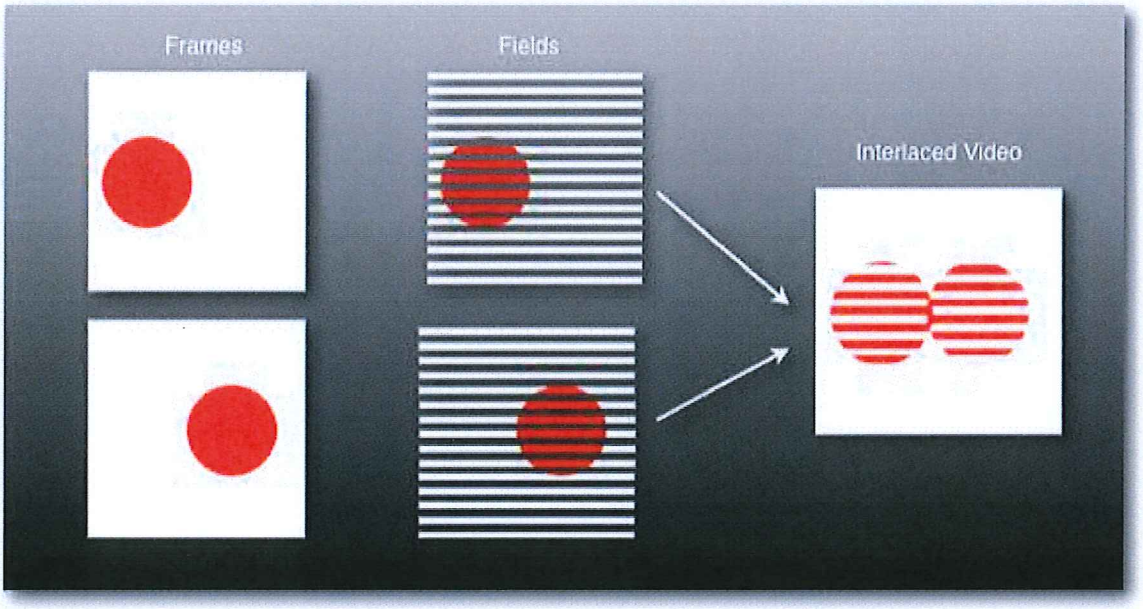


Figure 7 Motion artifacts due to interlacing when a moving object is filmed